2 TRANSPORTATION'S CONTRIBUTION TO THE ECONOMY

Transportation's contribution to the economy can be measured by its contribution to gross domestic product (GDP). GDP is an economic measure of all goods and services produced and consumed in the country. The transportation component of GDP can be measured as either:

- the share of all expenditures (by households, private firms, and the government) on final goods and services that are related to transportation (collectively known as the final demand for transportation), or
- the contribution of transportation services produced (known as value added) to GDP.

This chapter uses data from the Bureau of Economic Analysis' national income and product accounts and from the Bureau of Transportation Statistics' Transportation Satellite Accounts to explain and highlight trends in transportation's contribution to the economy.

Transportation-Related Final Demand

Transportation-related final demand (box 2-1) is a measure of the expenditures by households, private firms, and the government on final goods and services related to transportation. It is the sum of the following:

- personal consumption expenditures on transportation-related goods and services (motor vehicles and parts; motor vehicle fuels, lubricants, and fluids; and transportation services);
- private domestic investment in transportation structures and equipment;
- government purchases of transportation goods and services; and
- net exports (exports minus imports) related to transportation goods and services.

The first three expenditures (personal consumption expenditures, private investment, and government purchases of transportation related goods and services) sum to the domestic demand for transportation. If export and import values of transportation-related goods and services were equal—in other words, if net exports (exports minus imports) equaled zero—then the total transportation-related GDP would equal the sum of domestic demand for transportation. However, transportation-related imports tend to exceed exports, which results in net exports being negative. Negative net exports reduce the total for transportation-related final demand and result in transportation-related final demand being less than the sum of domestic sources of demand.

Transportation-related final demand is useful for comparing the amount spent on transportation to the amount spent on other economic activities, such as healthcare and

housing. It is not, however, a perfect measure of the transportation needed to support economic activity. For example, if investment in transportation infrastructure is below the level needed to maintain the system, then the measure will underestimate demand.

Box 2-1: National Income Account Terminology

The national income and product accounts use several related terms when discussing the size of the economy and sectors within the economy, such as transportation. These terms are used in the figures in this chapter and in other discussions of transportation economics.

What is Gross Domestic Product (GDP) and Gross Domestic Demand (GDD)?

- GDP is the sum of the value of all goods and services produced in the economy.
- GDD is like GDP but excludes net exports, thereby showing only domestic demand.

What are the differences among transportation value added, total transportation expenditures, and value of shipments?

Transportation value added is the contribution of transportation to the economy. It is equal to sales, or receipts, and other operating income from transportation services (gross output) less the goods and services used in production (intermediate inputs). Value added by transportation also can be measured as the sum of employee compensation, taxes on production and imports less subsidies, and gross operating surplus.

Transportation-related final demand is a measure of expenditures by households, private firms, and the government on final goods and services related to transportation. It is the sum of the following:

- personal consumption expenditures on transportation-related goods and services (motor vehicles and parts; motor vehicle fuels, lubricants, and fluids; and transportation services);
- private domestic investment in transportation structures and equipment;
- government purchases of transportation goods and services; and
- net exports (exports minus imports) related to transportation goods and services.

Value of shipments is the value of the goods transported by the freight transportation sector, which is different from the value of the service used to transport them.

Source: U.S. Department of Transportation, Bureau of Transportation Statistics, 2017.

Transportation-Related Final Demand by GDP Component

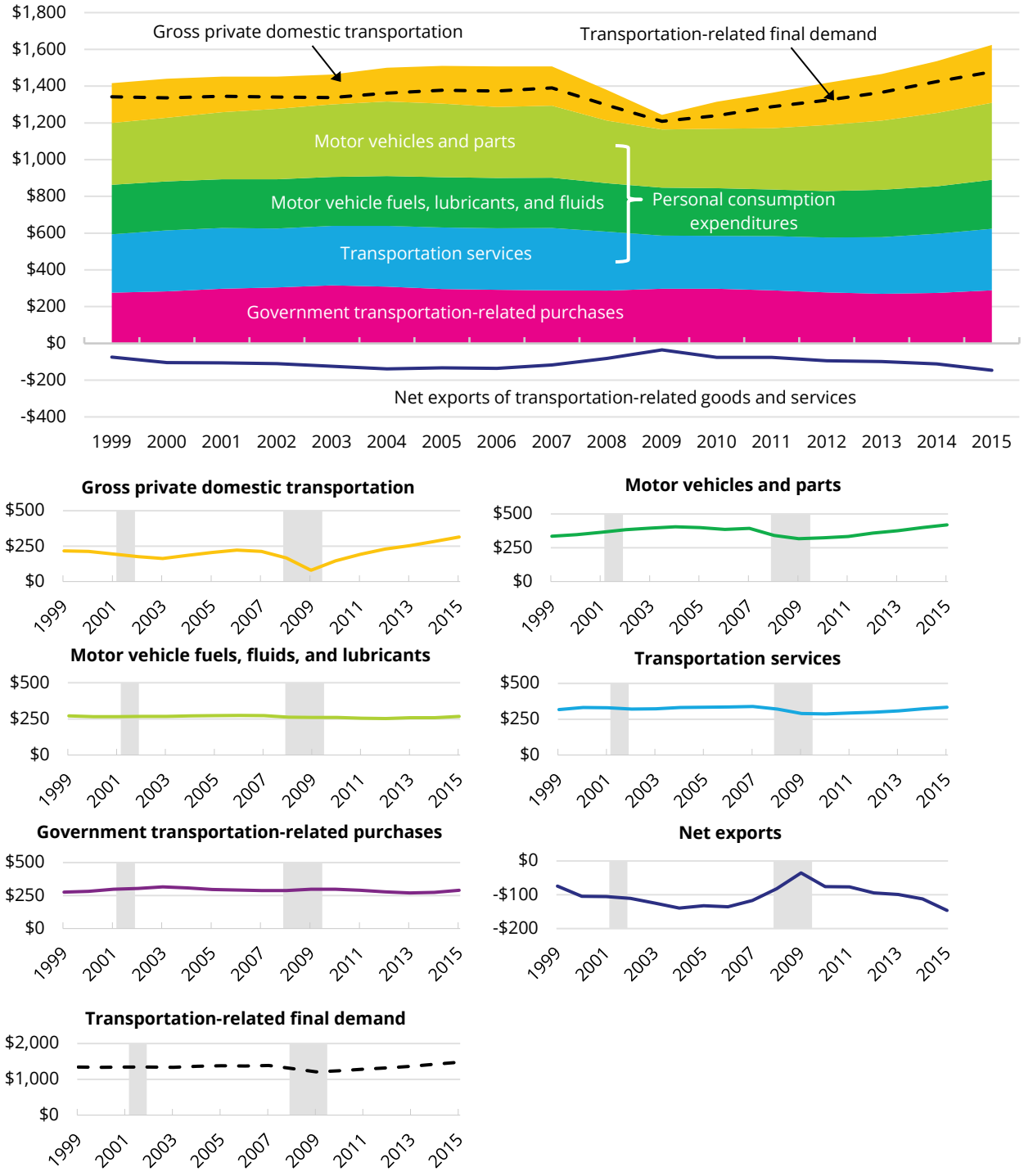
Figure 2-1 shows total transportation-related final demand from 1999 to 2015 (in chained 2009 dollars) and trends for each of its components (see box 2-1). Transportation-related final demand grew 3.5 percent from 1999 to 2007, peaking at $1,389.7 billion in 2007. It then fell 13.0 percent from 2007 to 2009 due to the recession, hitting an all-time low ($1,208.5 billion) in 2009. The sharp decline during the recession effectively removed over 10 years of growth in final demand. Transportation-related final demand has increased since the

recession, surpassing the 2007 peak in 2014 and continuing to climb in 2015. The average annual growth in transportation-related final demand was 3.4 percent between 2010 and 2015, compared to 0.4 percent between 2000 and 2007 (before the recession).

The decline in transportation-related final demand during the recession was most evident in private investment and in personal consumption expenditures (purchases of motor vehicle fuels, lubricants, and fluids; motor vehicles and parts; and transportation services). Exports of transportation goods and services came close to balancing imports in 2009—imports often decrease during economic declines—but returned to their larger negative balance in later years. Government transportation-related purchases peaked in 2003, and then declined steadily to $287.4 billion (in chained 2009 dollars) in 2008. They then rose in 2009 and 2010, as the government increased spending in response to the recession and to declines in private sector investment.

In 2015 the final demand for transportation ($1,477.9 billion) accounted for 9.0 percent of U.S. GDP (as measured in chained 2009 dollars). The demand included personal consumption expenditures of transportation ($1,020.7 billion, 69.1 percent of transportation demand), private domestic investment in transportation structures and equipment ($314.4 billion, 21.3 percent), government purchases of transportation goods and services ($289.1 billion, 19.6 percent), and net exports (exports minus imports) related to transportation goods and services (-$146.3 billion, -9.9 percent).

Figure 2-1: Gross Domestic Product (GDP) Components of Transportation-Related Final Demand, 1999 to 2015 (billions, chained 2009 dollars)



Source: U.S. Department of Transportation, Bureau of Transportation Statistics, National Transportation Statistics, Table 3-4, available at www.bts.gov. Current dollar data can be found in U.S. Department of Transportation, Bureau of Transportation Statistics, National Transportation Statistics, Table 3-3, available at www.bts.gov.

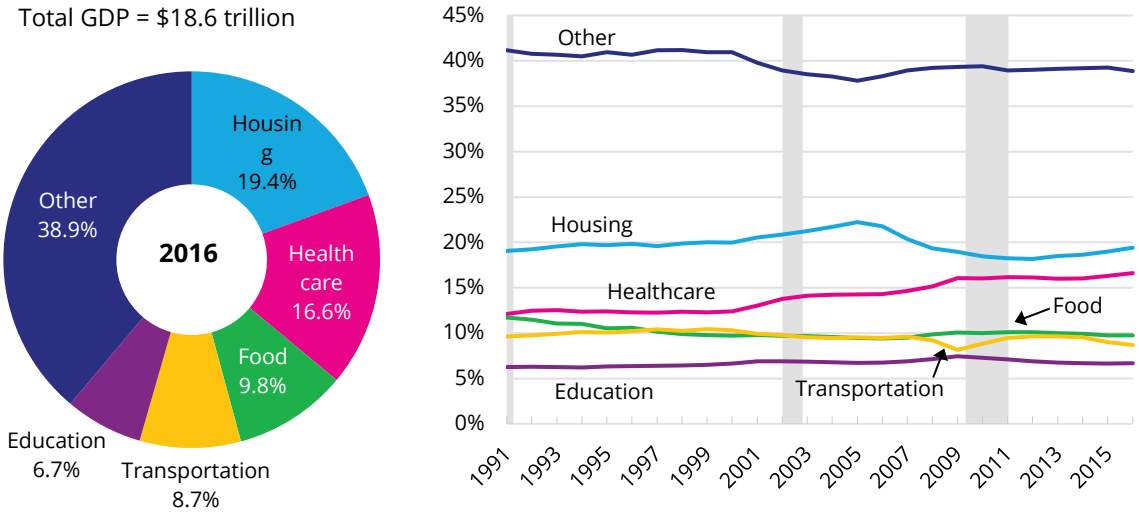
Gross Domestic Product (GDP) by Major Social Function

GDP by major social function shows expenditures (total final demand) on broad economic activities, such as housing, transportation, and healthcare. The major social functions—housing, healthcare, food, transportation, and education—comprise 60 percent of expenditures, while the 40 percent "other" category includes entertainment, personal care, and payments to pension plans.

Figure 2-2 shows that transportation was the fourth largest expenditure category in 2016 after healthcare, housing, and food (excluding "other expenditures"), representing 8.7 percent of total final demand. Housing is the largest source of final demand at 19.4 percent, slightly more than twice the size of transportation.

The right side of figure 2-2 shows expenditures by major social function from 1991 to 2016. Expenditures on transportation (transportation-related final demand) decreased during the recession from 9.6 percent of GDP in 2007 to 8.2 percent in 2009, and then increased slowly. Expenditures on transportation grew from 2009 to 2016, but the share of expenditures fell from 2012 to 2016 due to housing expenditures rising more rapidly.

Figure 2-2: Final Demand for Goods and Services by Major Social Function, 2016



Note: Shaded areas indicate economic recessions.

Source: U.S. Department of Transportation, Bureau of Transportation Statistics, *National Transportation Statistics*, table 3-9, available at www.bts.gov.

Contribution of Transportation Services Produced: Value Added

For-Hire Transportation Services Produced in the Economy

For-hire transportation services consist of air, rail, truck, passenger and ground transportation, pipeline, and other support services that transportation firms (e.g., transit

agencies and common carrier trucking companies) provide to industries and the public on a fee basis. Calculating the contribution of for-hire transportation to GDP uses a *value-added* approach that subtracts the cost of inputs (e.g., fuel and equipment costs) from total output (measured by industry revenue, e.g., airline fares).

Figure 2-3 shows how much transportation contributes to GDP relative to other industries. Each industry has an estimated contribution to GDP based on its *value added* (box 2-2). The value added by all industries sum to GDP. Since GDP is a measure of all economic activity, looking at industry value added shows where the most and least economic activity occurred. Transportation ranks 13th among the 17 industries in its contribution to GDP.

This ranking, however, understates the importance of transportation for two reasons. First, it includes only the contribution of for-hire transportation to GDP. In addition to purchasing for-hire transportation services, many industries produce transportation services for their own use. The services produced by non-transportation industries are known as in-house transportation. The *Transportation Satellite Accounts*, discussed later in this chapter, show the contribution of in-house transportation performed by non-transportation industries. Second, the ranking does not capture the extent to which industries rely on transportation. Each industry uses roadways, shipping channels, rail lines, and other transportation infrastructure to access supplies and customers, and workers in each industry use transportation to reach their workplace. The value of these transportation assets are discussed in Chapter 8.

Box 2-2: What is Transportation Value Added?

Transportation Value Added is a measure of the contribution of the transportation sector to gross domestic product (GDP) based on the difference between the value of the transportation services sold and the goods and services used to produce transportation. The Bureau of Economic Analysis (BEA) considers industry value added to be a measure of an industry's contribution to GDP.

The value of transportation sector outputs is estimated using data on the sales of transportation sector services to other parts of the economy. That shows what other parts of the economy are willing to pay for those services. Inputs purchased by the transportation sector, such as fuel and equipment, are valued based on what the transportation sector pays for them. The difference is the value added by the transportation sector, which is the transportation sector's contribution to GDP.

The contribution of the inputs to transportation includes the value added by the sector that produces them. For example, the contribution of the fuel purchased by for-hire carriers is included in the value added by the energy sector, which produced the fuel. If fuel purchased by for-hire transportation was not subtracted from the value added by transportation, it would be double-counting the value added by fuel. Other examples of excluded inputs include equipment, spare parts, lubricants, and other materials. This approach allows BEA to compute total GDP as the sum of the contributions of all sectors of the economy.

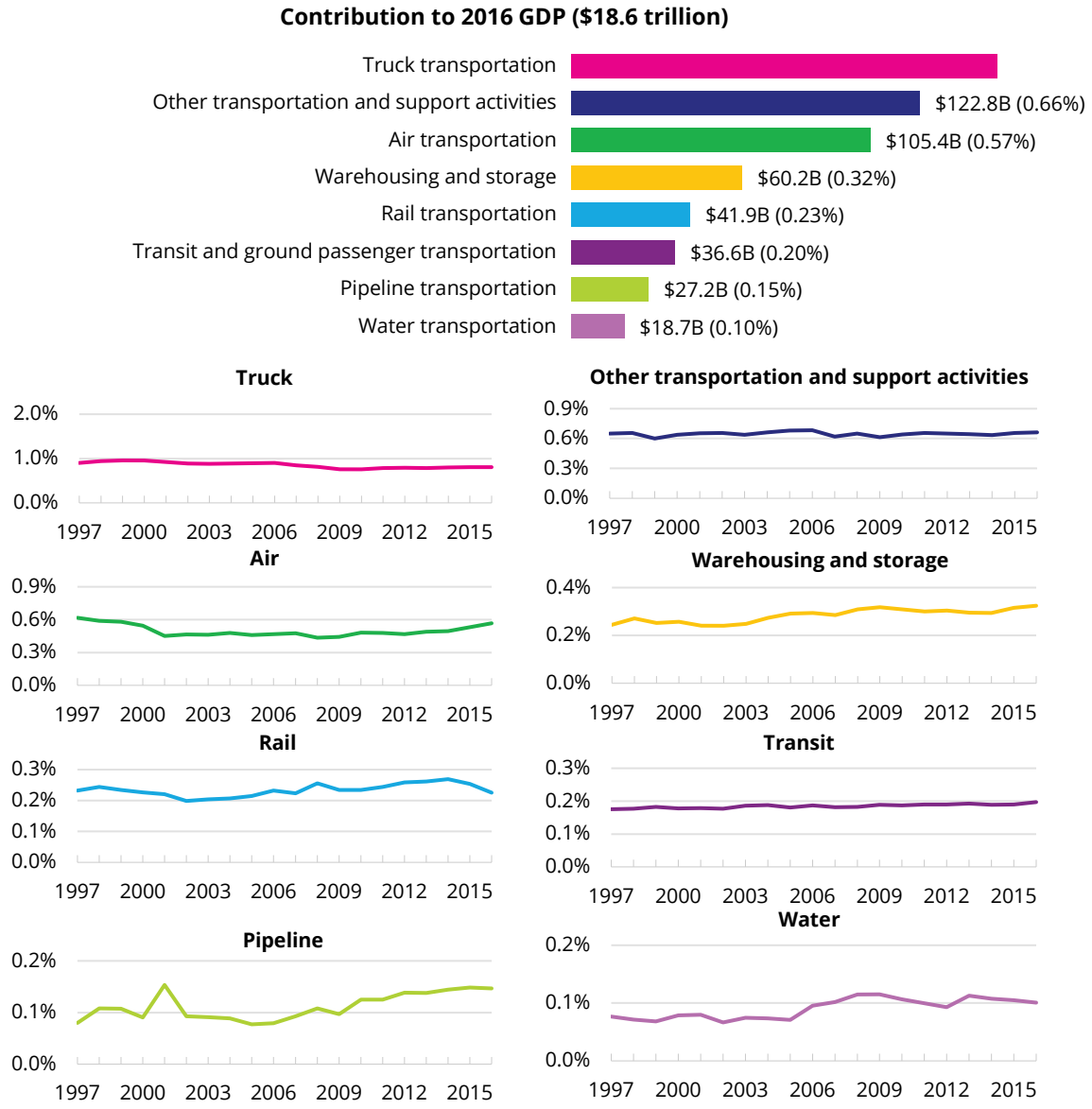
Source: U.S. Department of Transportation, Bureau of Transportation Statistics, 2017.

Figure 2-3: Contribution to Gross Domestic Product (GDP) by Industry, 2016

Source: U.S. Department of Commerce, Bureau of Economic Analysis, GDP by Industry table "Real Value Added by Industry (A) (Q)," available at www.bea.gov/iTable/index_industry_gdpIndy.cfm.

Figure 2-4 shows transportation's contribution to GDP by mode from 1997 to 2016. In 2016 the three modes with the largest contributions were trucking ($150.1 billion, 0.81 percent of GDP), other transportation and support activities ($122.8 billion, 0.66 percent), and air ($105.4 billion, 0.57 percent). The modes that grew as a percentage of GDP from 1997 to 2016 were warehousing and storage (from 0.24 percent to 0.32 percent), pipelines (from 0.08 percent to 0.15 percent, with peaks of 0.15 percent in 2001 and 2016), water (0.08 percent to 0.10 percent), and transit and ground passenger (from 0.18 percent to 0.20 percent). However, most modes decreased relative to GDP, including trucking (from 0.90 percent to 0.81 percent) and air (from 0.62 percent to 0.57 percent). Rail contributed the same percent in 2016 as in 1997 (0.23 percent), a slight decline from its peak contribution of 0.27 percent in 2014.

Figure 2-4: For-Hire Transportation Industry's Contribution to Gross Domestic Product (GDP) by Mode



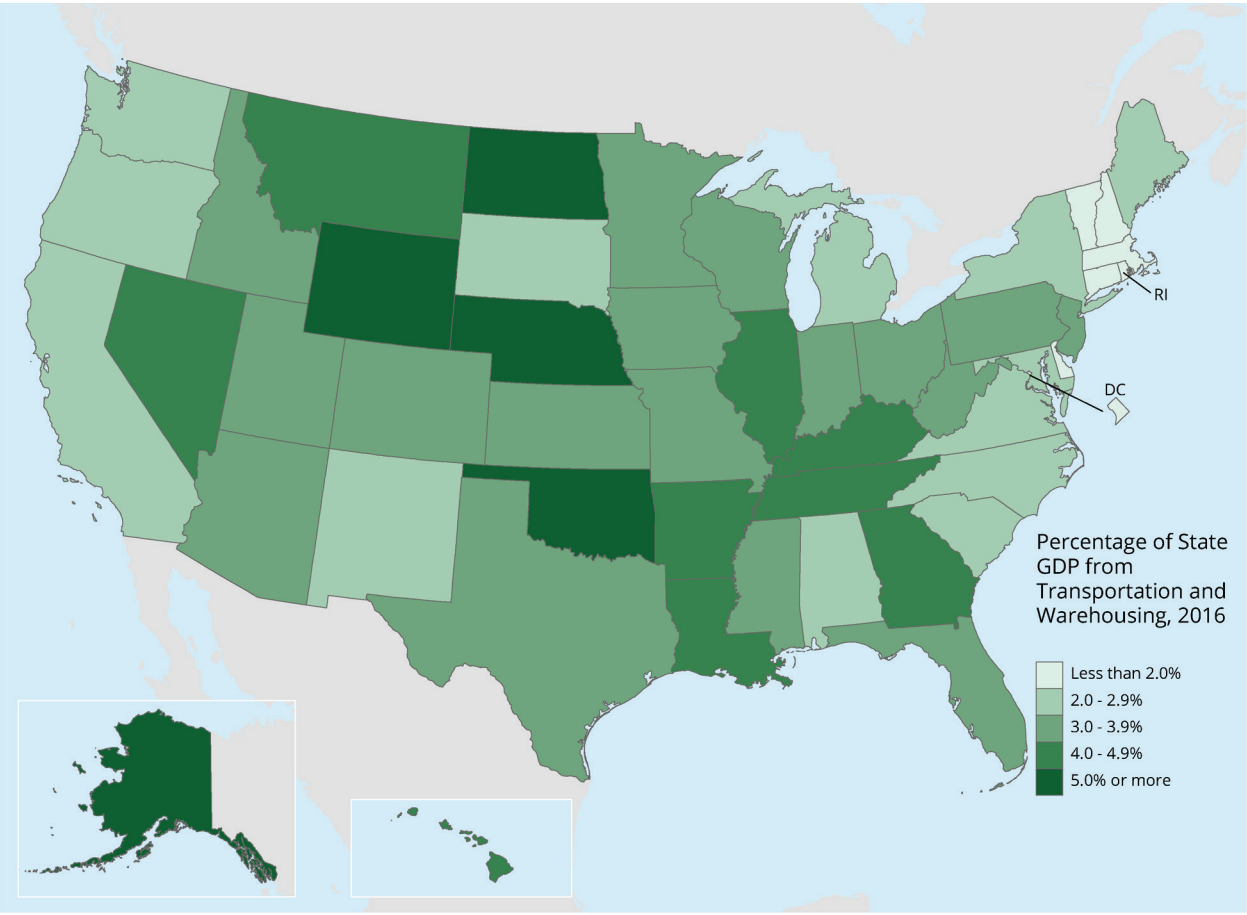
Notes: Data are from the value added by industry table of the BEA Industry Economic Accounts. Line 40 has data for Transportation and Warehousing, and Lines 41 through 48 have data for individual modes. Current dollar data can be found in *National Transportation Statistics,* table 3-1.

Source: U.S. Department of Transportation, Bureau of Transportation Statistics, *National Transportation Statistics*, table 3-2, available at www.bts.gov.

State Gross Domestic Product from Transportation and Warehousing

The percentage that transportation and warehousing contributes to a state's GDP depends on the state's geography, population density, mix of industries, and location of transportation hubs. For example, Nebraska has a major national rail hub in Omaha, and has the second-highest percentage of GDP from transportation and warehousing of any state in the country (7.8% of Nebraska's GDP in 2016). States with larger total GDPs, such as California ($2.6 trillion) and Texas ($1.62 trillion), also have large transportation and warehousing activities—$63.3 billion and $55.6 billion, respectively. Because other economic activities are so much larger in California and Texas, however, transportation and warehousing is a small share of their total GDP (figure 2-5).

Figure 2-5: State Gross Domestic Product from Transportation and Warehousing as a Percent of State Total Gross Domestic Product, 2016



Source: U.S. Department of Commerce, Bureau of Economic Analysis, "Regional GDP & Personal Income," available at www.bea.gov/iTable/index_regional.cfm.

Transportation Satellite Accounts

The Bureau of Economic Analysis (BEA) measures the value added by for-hire transportation using the Economic Census Survey. *For-hire transportation services* are produced by transportation firms (trucking companies, railroads, and airlines) and sold to transportation users. In addition to for-hire transportation services, non-transportation industries also produce transportation services for their own purposes. For instance, grocery stores may operate a truck fleet to move food from distribution centers to stores. BEA embeds the value of these services, known as *in-house transportation*, within the value of the goods purchased by non-transportation industries to carry out in-house transportation operations.

BTS developed the *Transportation Satellite Accounts* (TSAs, box 2-3*)* to extract the commodities used to carry out in-house transportation operations and estimate the contribution of in-house transportation to the economy. The TSAs also show the contribution of transportation carried out by households using automobiles. The TSAs thus give a more comprehensive measure of the size and role of transportation in the economy.

Box 2-3: What are the Transportation Satellite Accounts (TSAs)?

Satellite industry accounts expand on the national income and product accounts and the input-output accounts, and supplement these accounts by focusing on one aspect of economic activity. The TSAs capture transportation activities carried out by non-transportation industries for their own purposes and transportation activities carried out by households using an automobile.

The TSAs show the contribution of for-hire, in-house, and household transportation services:

- *For-hire transportation* consists of the air, rail, truck, passenger and ground transportation, pipeline, and other support services provided by transportation firms such as railroads, transit agencies, common carrier trucking companies, and pipelines to industries and the public on a fee basis.
- *In-house transportation* consists of air, rail, water, and truck services produced by businesses for their own use. Business in-house transportation includes privately owned and operated vehicles of all body types, used primarily on public rights of way, and the support services to store, maintain, and operate those vehicles. A baker's delivery truck is an example of in-house transportation.
- *Household transportation* covers transportation provided by households for their own use using a vehicle, measured by the depreciation cost associated with household ownership of motor vehicles. Air passenger travel is included in for-hire air transportation. The time that households spend operating a private motor vehicle for personal use is not included, because it is outside the scope of the U.S. Input-Output (I-O) accounts on which the TSAs are built.

The I-O accounts do not include unpaid labor, volunteer work, and other non-market production.

Source: U.S. Department of Transportation, Bureau of Transportation Statistics, 2017.

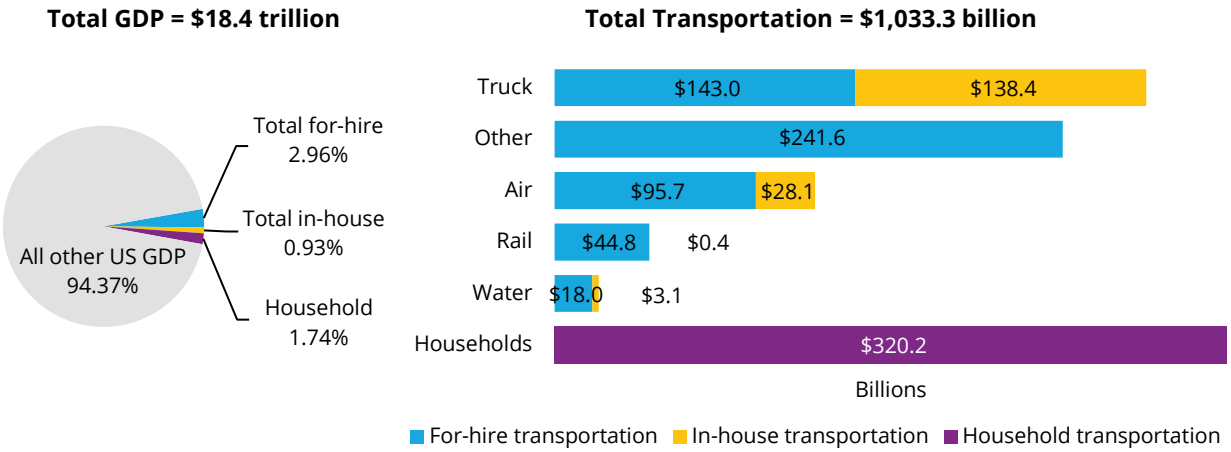
Transportation Satellite Account Results

The TSAs compute transportation's GDP contribution attributed to all transportation modes. In 2015, the latest year for which comprehensive data are available, transportation's total GDP contribution was estimated at $1,033.3 billion (figure 2-6). The pie chart in figure 2-6 represents total U.S. GDP, and the slice shows the portion contributed by transportation, based on the TSAs. The colors within the slice show the relative shares of for-hire (3.0 percent), in-house (0.9 percent), and household (1.7 percent) transportation's contribution to GDP. For-hire transportation contributed $543.2 billion (3.0 percent) to U.S. GDP of $18.4 trillion.[1] Transportation services (air, rail, truck, and water) provided by non-transportation industries for their own use (called in-house transportation) contributed an additional $169.9 billion (0.9 percent) to U.S. GDP.[2] Household transportation (i.e., the depreciation cost associated with households owning motor vehicles)[3] contributed $320.2 billion (1.7 percent) to U.S. GDP.

[1] The GDP value in the TSAs is larger than the GDP value published in the national income and product accounts because it includes the contribution of household transportation. Household transportation covers transportation provided by households for their own use with an automobile.
[2] Large retailers, such as Walmart and Target, are captured by BEA in the for-hire transportation sector, but smaller retailers are subsumed into the BTS in-house estimate.
[3] In the TSAs, BTS measures the contribution of household transportation to GDP as the depreciation of automobiles. The measure does not include the value of time spent driving because it is not within the scope of the U.S. Input-Output accounts on which the TSAs are built. The I-O accounts, by design, do not include unpaid labor, volunteer work, or other non-market production.

The bars in figure 2-6 show transportation's contribution to GDP by type (for-hire, in-house, or household transportation) and by mode for for-hire and in-house transportation. Total household transportation's contribution to GDP was larger, at $320.2 billion, than any of the other transportation modes. Trucking contributed the second largest amount, at $281.4 billion. In-house truck transportation operations (such as a grocery chain operating its own trucks) contributed $138.4 billion, while for-hire truck transportation services contributed $143.0 billion. Air contributed a total of $123.8 billion, comprised of $95.7 billion of for-hire services and $28.1 billion of in-house services; rail contributed $45.2 billion, comprised of $44.8 billion of for-hire services and $0.4 billion of in-house services; and water contributed $21.0 billion, comprised of $18.0 billion of for-hire services and $3.1 billion of in-house services.

Figure 2-6: Gross Domestic Product (GDP) Attributed to Transportation Types and Modes, 2015



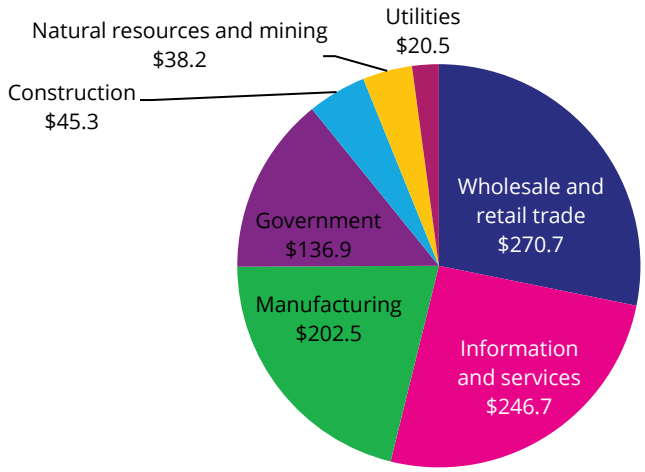
Note: For information on the methodology behind the Transportation Satellite Accounts see box 2-3. The GDP value in the TSAs is larger than the GDP value published in the National Accounts because it includes the contribution of household transportation. "Household transportation" covers transportation that households provide for themselves with vehicles.

Sources: U.S. Department of Commerce, Bureau of Economic Analysis, "Regional GDP & Personal Income," available at www.bea.gov/iTable/index_regional.cfm. U.S. Department of Transportation, Bureau of Transportation Statistics, Transportation Satellite Accounts, available at www.bts.gov.

Use of For-Hire and In-House Transportation by Industry

The TSAs can also compute the extent of transportation services required to produce various goods and services. Figure 2-7 compares the value of for-hire and in-house transportation services used by seven major industries to produce their goods and services. When in-house transportation is included, wholesale and retail trade is the largest user of transportation services at $270.7 billion, followed by information and services at $246.7 billion and manufacturing at $202.5 billion.

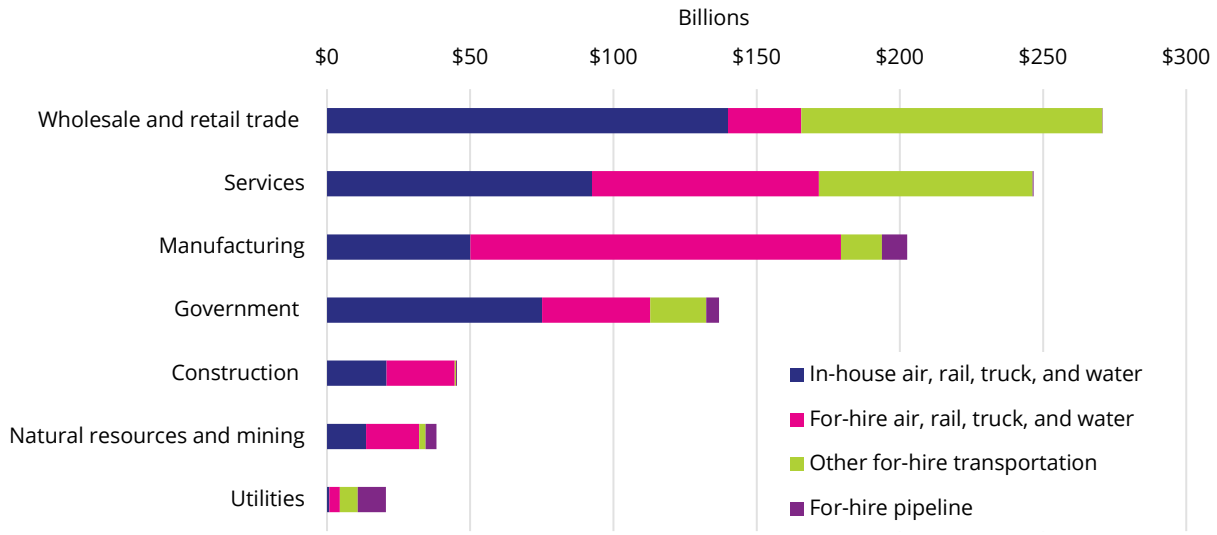
Figure 2-7: Use of For-Hire and In-House Transportation by Industry Sector, 2015 (billions of dollars)



Source: U.S. Department of Transportation, Bureau of Transportation Statistics, Transportation Satellite Accounts, available at www.bts.gov.

In the wholesale and retail trade industry, in-house transportation accounts for 51.7 percent of the $270.7 billion total transportation services used (figure 2-8). In-house transportation also represents a large portion of transportation services used in natural resources/mining (35.5 percent of $38.2 billion), construction (45.8 percent of $45.3 billion), and government (54.9 percent of $136.9 billion). Other sectors, like manufacturing, rely more on for-hire transportation. In the manufacturing sector, for-hire transportation accounts for 75.3 percent of the $202.5 billion total transportation services used.

Figure 2-8: Use of For-hire and In-house Transportation by Industry Sector and Mode, 2015 (billions of dollars)



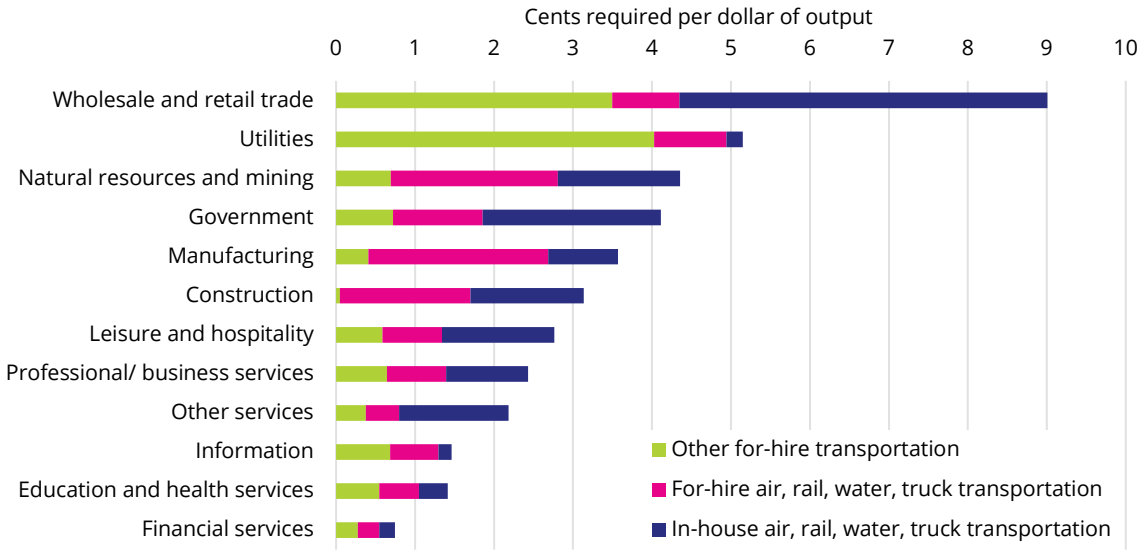
Notes: Pipeline transportation is shown separately only for the natural resources and mining and the utilities industries. It accounts for less than 5 percent of total transportation used by other industries. Services includes: information, financial services, professional and business services, education and health services, leisure and hospitality, and all other services.

Source: U.S. Department of Transportation, Bureau of Transportation Statistics, Transportation Satellite Accounts, available at www.bts.gov.

Transportation Required Per Dollar of Output by Sector

Looking at the amount of transportation required to produce each dollar of output shows how much a sector depends on transportation (figure 2-9). In 2015 the wholesale and retail trade sector required more transportation services to produce one dollar of output than any other sector. It required 9.0 cents of transportation services to produce one dollar of output—4.7 cents of in-house transportation operations, and 4.4 cents of for-hire transportation services. BTS fully discusses transportation's role in the seven major industry sectors in Industry Snapshots: Transportation's Role in the U.S. Economy, available at www.bts.gov.

Figure 2-9: Transportation Required Per Dollar of Output by Sector, 2015



Source: U.S. Department of Transportation, Bureau of Transportation Statistics, Transportation Satellite Accounts, available at www.bts.gov.